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THESIS

AUTOMATING AVIATION TRAINING RECORDS

by

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September 2000

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Over the years with advances in computer technology, the navy has gradually transitioned into a paperless operation. Personnel training records have provided a standardized, documentable individual qualification record for Navy aviation maintenance personnel, however these records continue to be kept in folders, stored in file cabinets. In addition, paper records create a maintenance burden, in that the continued handling and possibility of errors made during data entry and normal wear and tear of documents contained in these records, require pages to be periodically repaired, replaced or completely recreated. A torn and missing page also causes valuable training information to become lost, decreasing the information integrity of the record.

This thesis will examine the benefits and problems in automating aviation training records, and further discuss database design issues and considerations to maximize the flexibility and functionality provided by automation. Incorporating a distributed database is discussed as a solution, with further discussion on further considerations for the proper implementation of a training record database. Interface and alternate local networking options will also be discussed. Recommendations for further research is also presented.

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AUTOMATING AVIATION TRAINING RECORDS

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ABSTRACT

Over the years with advances in computer technology, the navy has gradually transitioned into a paperless operation. Personnel training records have provided a standardized, documentable individual qualification record for Navy aviation maintenance personnel, however these records continue to be kept in folders, stored in file cabinets. In addition, paper records create a maintenance burden, in that the continued handling and possibility of errors made during data entry and normal wear and tear of documents contained in these records, require pages to be periodically repaired, replaced or completely recreated. A torn and missing page also causes valuable training information to become lost, decreasing the information integrity of the record.

This thesis will examine the benefits and problems in automating aviation training records, and further discuss database design issues and considerations to maximize the flexibility and functionality provided by automation. Incorporating a distributed database is discussed as a solution, with further discussion on further considerations for the proper implementation of a training record database. Interface and alternate local networking options will also be discussed. Recommendations for further research is also presented.

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I. INTRODUCTION

> Information technology is the answer to an uncluttered work environment. Imagine a clean desk with a pristine PC upon it - this is the dream of the paperless office. "It heralds the final frontier, a comfortable, stress-free waiting room for office workers just outside the gates of heaven" (Sanders, 1995, page 56).

As Computer technology advances, the Navy, along with the rest of the world, has gradually moved into a "paperless" society. Computers have allowed us to store hundreds of megabytes of information in databases, eliminating the need for storage facilities, such as filing cabinets, and aiding in facilitating maintenance on paper files that wear out over time, through daily handling. Despite the advances in computer and database technology the aviation training records have remained stored in paper folders. These records are maintained by a training petty officer, who makes all required entries as each individual completes his or her specific training evolution, obtains licenses and completes advanced training from various service schools. Automating these records would alleviate or even eliminate problems with upkeep, documentation, and data availability of these records.

A. PURPOSE

With the increased requirements for qualifications and licenses aviation maintenance personnel must obtain to repair the Navy's complex aircraft, managing and assigning qualified personnel become an important part of managing maintenance. This thesis will discuss the benefits of using a distributed database over LAN/WAN connections to increase the potential that database sharing can provide in data

documentation and availability. This thesis will also analyze aviation command missions and personnel mobilization requirements in order to determine database functionality considerations.

The thesis will also touch on implementation design and desired functionality of the application program. As well as, network implementation strategies and risk management considerations.

B. ASSUMPTIONS

The research was based on the assumption that naval squadrons had local area networks (LANs) or were in the process of developing or planning one.

C. THESIS OUTLINE

This section contains a brief summary of the thesis chapters.

1. Chapter I. Introduction

This chapter describes the purpose of the thesis, a few assumptions, a thesis outline and expected benefits of the thesis.

2. Chapter II. The Problem With Paper Records

This chapter discusses the problems encountered by the workcenter training petty officer and aviation maintenance managers with aviation training records in paper form. It also discusses the benefits realized by automating these records.

3. Chapter III. Problem Analysis

This chapter analyzes the mobility requirements of aviation commands and the database consideration as a result.

4. Chapter IV. Transaction Processing Issues

Considerations for processing transactions to the training record database is discussed, including data integrity and connectivity issues and considerations.

5. Chapter V. Application Program Design

This chapter suggests considerations for design of the application program, including desired functionality and possible interface design.

6. Chapter VI. LAN Implementation Considerations

Considerations for implementing training records on a network are discussed in this chapter. The different network applications are discussed, along with advantages and disadvantages of each method.

7. Chapter VII. Risk Management

This chapter suggests steps to be taken for risk management of the training record database including backup methods and use of external media.

8. Chapter VIII. Recommendations and Conclusions

This chapter discusses conclusions made as a result of thesis research and makes recommendations for implementing the automation of aviation training records.

D. EXPECTED BENEFITS OF THIS THESIS

This thesis was written to develop awareness of the benefits of automating aviation training records and eliminate the current paper form. A benefit of this thesis is to lay the ground work for a follow on thesis researcher to design a working prototype and expedite it's implementation in fleet commands. As a result of this thesis, there should be a better understanding of what methods are available and required for the automation of aviation training records, with possible uses in communities, other than aviation, who might still be maintaining training records or any other types records in paper form. It is hoped that this thesis will help in continuing the move to a "paperless" Navy.

II. THE PROBLEM WITH PAPER RECORDS

A. WHY KEEP TRAINING RECORDS?

Today's naval aircraft, contain complex weapons, navigation and flight control systems. These systems require highly skilled and knowledgeable maintenance personnel to safely and effectively perform both scheduled and unscheduled maintenance to keep naval aircraft mission ready. Maintenance personnel must be qualified and possess licenses to operate Ground Support Equipment (GSE) and heavy machinery, such as cranes and tractors in support of the maintenance effort. (Matheson, 1999) In addition to technical training, aviation personnel are required to receive instruction on subjects ranging from financial management to fighting aircraft and shipboard fires, to ensure that personnel are ready to handle personal or emergency situations in the rigorous, disciplined environment of the military. Training records provide a standardized, documentable individual qualification record for naval aviation maintenance personnel. (OPNAVINST 4790.2G, Volume V, Chapter 2, para 2.4i)

A. THE PROBLEM WITH PAPER

The OPNAVINST 4790.2G dictates that:

> The training record (in a standard 9x12 folder) shall be initiated for each enlisted member of the activity and shall accompany the member upon transfer. The forms/formats listed in paragraphs 2.4 i(2) and 2.4 i(3) are mandatory, in the order indicated. The training record will only contain documents required by individuals to perform their current duties (OPNAVINST 4790.2G, Volume V, Chapter 2, para 2.4 i(1)).

The OPNAVINST 4790 has been affectionately referred to as the "NAMP Bible" by aviation maintenance personnel. It has provided guidance for generations of naval aircraft maintainers and is to be followed to the letter unless a waiver of deviation is granted for extraneous circumstances. The instruction, however, does not provide adequate, detailed guidance necessary to make these records standardized. Appendix A contains further guidance on the NAMP requirements for training record structure. Problems with paper records include but are not limited to:

- **Creation of Non-Standardized Folders**

  As stated previously, aviation training records are to be kept in a standard 9X12 folder, however, it does not provide further guidance on the type of material in which the folder is to be constructed or whether or not the folder should contain pre-secured fasteners or fasteners inserted through holes made with a two hole punch. Regardless, using two-hole fasteners is the normal method in which paper documents are secured inside the folder. This results in interpretation by the records custodian, of what materials are sufficient for training records leading to non-standardization of these records.

- **Illegible Pen and Ink Documentation**

  As training is completed and qualifications are attained, the Training Petty Officer will make a hand-written entry in the appropriate section of the folder or will insert formal school completion certificates and/or any printed sheets containing data required for individuals to perform their current duties, such as medical certifications and billet/collateral duty descriptions. Hand-written entries can become illegible depending on the penmanship of the individual making the entry. If entries cannot be properly read, the entry could be confusing or completely unusable. Repeated corrections creates cluttered pages and possible

questions concerning authenticity of data, requiring complete reconstruction of these pages.

- **Wear from Repeated Handling**

A diligent Workcenter Training Petty Officer will periodically check each record under his/her responsibility for completeness and accuracy in addition to making entries when required. This calls for records to be handled on a fairly consistent basis depending on the habits of the records custodian. In addition, transferring personnel are required to hand-carry their individual training record to their next command (OPNAVINST 4790.2G, Volume V, Chapter 2, para 2.4 i(1)). As a result of the continuous handling of these records, folders become worn, fasteners become weak and break from repeated bending during removal and insertion of pages, sheets become torn or are ripped from their fasteners through the punched holes at the top of the page. This could possibly lead to missing certifications or training documentation sheets, which would need to be replaced or duplicated. To prevent this, Training Petty Officers are required to perform periodic preventive maintenance and repair of records under their responsibility. Depending on the size of the workcenter, these repairs could take minutes to perform in a workcenter of four personnel, to hours in a workcenter of thirty or more personnel. In a workcenter with limited manpower, valuable manhours spent on training records repair could have been better spent on performing aircraft maintenance.

- **Storage and Security Requirements**

In addition to repairs, training records must be stored in filing cabinets and again, depending on the size of the workcenter and the number of records to be stored, this could be a needless space requirement.

The training record is an official record of qualifications required for a member to perform his or her duties, therefore, it is a good practice to limit

training record access to authorized individuals to prevent disclosure of privacy act information and the possibility of false training entries by unauthorized personnel. Unless a file cabinet has the capability to be secured, training records will be accessible to all personnel.

B. DESIRED FUNCTIONAL REQUIREMENTS

Prior to computer technology and the desktop PC, business was conducted by manually filling out a paper document, either by writing entries by hand or by using a typewriter (an electric, if you were high tech), in the performance of daily operations. Record keeping consisted of paper files stored in filing cabinet drawers. Sharing information from these files with others from outside of the command may have consisted of making a copy of the documents on the copy machine, placing the copied documents in an envelope and mailing the envelope to the requester. This process was often slow and cumbersome. Many of the documents contained redundant information. When data changed, such as a persons mailing address, each document would need to be manually updated to ensure data consistency. Even so, the accuracy of the data could still be in question, depending on the which documents were updated and when the update was made.

Aviation training records suffer this same dilemma. As automation has increased efficiency in areas, such as communication (i.e. email) and word processing, technology has yet to play a role in the upkeep and sharing of aviation training record data. In paper form, the data documented in these records cannot be used to the full potential that

automation provides. Using today's computer technology, further functionality of training records could be expanded to provide:

- **Data Integration**

  Identical data, such as an individual's name, is a common entry found on practically every page in a training folder. Although this data seldom changes, there are occasions when it might, as is the case of a change in last name resulting from marriage. Paper records require each page be manually updated. Training records should provide a method of integrating redundant entries allowing data to be updated once, with the change being automatically reflected on each document.

- **Data Updates**

  Service schools maintain a information database of each attending student, including, for example, courses taken and dates of completion. This information must also be documented in the individual's training record as well. Updating record entries should allow as little duplication of effort as possible. A mechanism to provide updates entered by a command, such as a school should be a two fold process, with the entry being reflected in the individual training record as well.

- **Data Authentication**

  The only method of authenticating data in a training record is by initial or signature of the instructor or the person making the entry. Signatures and initials are easily forged and can bring into question the authenticity of the entry. Data authentication must be assured to ensure record accuracy.

- **Data Availability**

  Record data should be readily available when required, not only by the maintenance manager in the parent command, but also others requiring

information to generate various reports and queries, such as the Air Department Officer on a carrier attempting to determine which crewmembers are qualified to hook an aircraft to the catapult. This information should be readily available by querying only selected portions of the record vice having to perform an extensive manual search through pages of paper.

In addition, training record data should be available to personnel on detachment in remote locations without impacting the availability of the record of personnel in the parent command.

- **Data Security**

Although information in these records are not classified, aggregate data from these records is an indicator of unit readiness and may have confidentiality requirements, therefore, measures should be taken to safeguard entries from unauthorized personnel to assure record accuracy and integrity.

C. AUTOMATING TRAINING RECORDS AS A SOLUTION

In the late 70s and early 80s, the vision of a "paperless society" were major buzzwords as a result of advances in computer technology. The DoD, along with the rest of the world, has slowly transitioned into a paperless society, however, there are still areas were implementing automation can further fulfill this vision and pay tremendous dividends in efficiency. Today, aviation training records remain in paper form. Automating these records into a central relational database will enhance record maintenance and upkeep, providing:

- **Standardization**

Folders are no longer required to keep paper copies, rather, individual records will be maintained in one standard database and/or kept on removable

media such as a 3.5" floppy disk, Zip disk, smartcard, or rewriteable CDROM. All forms and entry sheets will be in a standard, extensible, formatted, electronic form.

- **Reduced Documentation Errors**

Workcenter Training Petty Officers are human and prone to errors while making handwritten entries. Technology provided by Commercial-Off-The-Shelf (COTS) software, such as, Microsoft Word and other forms producing programs, allows forms to be generated using entry fields formatted to perform "edit checking" only accepting standard formatted entries. COTS also allows for the use of list boxes with predetermined entries in which to choose from. The person making an entry will only be allowed to choose from certain entries and will not be allowed to use or spell an entry any different than what appears in the list box. Since the forms are typewritten, entries will be legible with standard type and easily correctable if an error is made.

- **Reduced Maintenance and Repair Time**

Automating training records eliminates the need to repair worn or torn folders, fasteners and pages. Service school completions and medical certifications for an individual, could be entered into the database or downloaded from the issuing activity via a modem or LAN/WAN connectivity. By using backed up data, records could easily be reconstructed in case of database corruption.

- **Portability**

Through LAN/WAN technology, database information will be available to other commands. For example, records of transferring personnel could be downloaded by the receiving command by connecting to the transferring command's master database and upload the individual's training information over

the web or intranet. On occasions when this is not possible, the bulk of the transfer envelope will be reduced by downloading the member's training record on a floppy or Zip disk for transport and later upload to the receiving commands training database. Files could be incorporated with digital signatures, to ensure entries were not altered or "adjusted" in transit by unauthorized personnel. A remote located squadron detachment will be able to access and update records of personnel through a modem or LAN/WAN access if available.

- **Reduced Storage Requirements**

File cabinets will no longer be required for storage of training folders, rather all training information will be stored in a database on a server or stored on magnetic media, such as floppy or Zip disks, which will take up a fraction of the space.

- **Limited Access**

Databases incorporate security functions to limit access to and provide users with the functionality required for their billet. In addition, security is further enhanced by using features available in network operating systems, such as Windows NT, which allows an administrator to limit access to files and databases by setting user restrictions and limiting access to authorized users through password authentication procedures.

- **Interoperability**

Automated training records will contain identical personnel and training information with other DoD training databases, such as the Standard Training Activity Support System (STASS). STASS is a Chief of Naval Education and Training (CNET) automated information system designed to improve training activity and schoolhouse management and administrative functions. It provides support for training activities/schoolhouses in the functional areas of personnel

management, student training management, classroom support management, class event and resource scheduling, publication and equipment management, system utilities, student testing and evaluation, user feedback reporting, and related administrative support. (CNETINST 1510.3) The STASS personnel subsystem functions include tracking student training qualification history, General Military Training (GMT) and administrative and personnel related data. Automating training records will allow these two databases to interconnect through Local Area Network (LAN)/Wide Area Network (WAN) technology to cross-reference information contained in each database. For example, An individual command may access STASS to update school completion information on a student and similarly, the STASS database can obtain administrative information, and training completion and qualification history from the command's record database.

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III. PROBLEM ANALYSIS

The key mechanism of an automated training record system lies in the database itself. The potential benefits of the database depends on an analysis of operational requirements of a command both on shore and at sea, in order to greater understand database implementation requirements. The training record database will service platforms of different sizes, computing capabilities, and mobility. This requires the database architecture be as robust and mobile as possible in order to meet the requirements of these various platforms. This chapter will discuss and analyze the degree of command and personnel mobility of the various types of aviation units, and the issues to be considered in determining database requirements for the automated service record.

A. COMMAND OPERATIONS

The missions of the various aviation commands vary both in resources available and required qualifications of assigned personnel. They do, however, share commonalities such as:

- All employ aviation personnel
- All use highly complex equipment requiring qualifications to operate
- Assigned personnel qualifications must be maintained on aviation personnel to operate this complex equipment
- All assigned aviation personnel require a training record be maintained as per the OPNAVINST 4790.2G

1. Shore-based Commands

Shore-based commands are normally non-deployed entities, such as a training squadron or an Aircraft Intermediate Maintenance Department (AIMD) assigned to a Naval Air Station or overseas base. These commands typically are not mobile and maintain land-based facility resources (i.e. network backbone). The scope of their mission consists of support to fleet commands, either in repair of parts that are beyond the capabilities of the squadron or training personnel for further assignment to fleet billets. Shore-based commands do not normally deploy personnel, although shore AIMDs may employ a Sea Operational Detachment (SEAOPDET), a sea duty billet consisting of personnel who are assigned to shipboard AIMDs for manning level augmentation during deployment cycles. While not on deployment, these personnel are transferred back to the shore AIMD until the next deployment cycle. Training records for SEAOPDET personnel normally accompany the individual on deployment in order to maintain record upkeep.

2. Aircraft Squadrons

An aircraft squadron's mission is to provide required air assets anywhere in the world. Although each type aircraft may provide different capabilities, one commonality that all aircraft squadrons possess is that they are highly mobile. When a squadron boards a ship for deployment, or in the case of a P-3 Orion squadron, deploys to a remote overseas shore base, the command usually packs up all squadron assets and completely vacates spaces they occupied in the hangar. Upon return from deployment, the squadron

may or may not return to the original space occupied prior to deployment, rather they may be rotated to an available space until the next deployment cycle.

Between deployment cycles, squadrons will participate in training exercises in order to maintain mission readiness. These exercises (sometimes a week or more in duration) are often conducted at remote locations by a small squadron detachment, with personnel manning levels dependent on the number of squadron aircraft participating.

3. Shipboard Operations

Ships deploy to remote areas around the world at a moment's notice. A normal deployment is six months in duration but may be often extended for months at a time, depending on the availability of a relief or during times of conflict as needed. In addition, a day or two prior to deployment an aircraft carrier will embark an aviation airwing, consisting of approximately 7 to 8 squadrons, for the duration of the deployment.

B. PERSONNEL TRANSFERS

Personnel rotate between the various platforms during the course of their career as part of their sea/shore rotation. For example, personnel may fulfill their sea duty obligation in a squadron and transfer to an AIMD for a shore duty tour. The training record must follow the individual during transfer to his or her next command. Although many qualifications are only applicable to particular platforms, such as the carrier arresting gear system, many qualifications are transferable and normally remain current at the follow-on command, such as operating licenses for common support equipment.

C. SERVICE SCHOOLS

Throughout a sailor's career, he or she will, more than likely, attend some sort of formal service school. These schools train fleet personnel to operate the complex systems employed throughout the fleet. In addition, qualifications often require the individual attend a formal school before the individual can be considered fully qualified, as is the case with shipboard firefighting, for example. Personnel usually attend these schools manning levels of qualified personnel deplete, or as operational commitments permit the temporary absence of personnel. Service schools maintain their own database of personnel information, including personal identification data, courses attended and completion dates.

D. DATABASE SYSTEM REQUIREMENTS

Based on command and personnel operational analysis, we can further analyze the database architectural requirements for optimization of training record applications.

1. Loosely vs Tightly Coupled Systems

Coupling deals with the level of interdependence of the database systems. Tightly coupled systems are highly interdependent with the other segments of the databases in the system, while loosely coupled systems are less interdependent and can be maintained separate from the other segments and still provide needed functionality. As discussed earlier, aviation commands are characterized by their high mobility. Continuous connectivity to another segment of the database is not guaranteed and can often be an impossibility for long periods of time, as in the case of the aircraft carrier on deployment.

These commands must be able to continue functioning without interdependence to the other databases, therefore loosely a coupled system is required for the training record model.

2. Distributed Database

A distributed database can be defined as consisting of a collection of data with different parts under the control of separate database management systems (DBMS) running on independent computer systems. (Dublin, 1995) All computers have the capability to interconnect and each system has autonomous processing capability serving local applications. Each system participates, as well, in the execution of one or more global applications. Such applications require data from more than one site. This type of database is ideal for sharing training record information between the parent commands and the various service schools. This is especially true for command detachments using a laptop computer to maintain a separate training record database of personnel assigned to the detachment.

Figure 1 illustrates the interface relationship between the components in a typical distributed database architecture. (Noel, 1997) The key focus for the automated training record system lies in the distributed database management system (DDBMS). In this major system, a client program acts as an interface to the Distributed Transaction Manager (DTM) and accepts user's requests for transactions. The distributed transaction manager is a program that translates requests from the user and converts them into actionable requests for the database managers, which are typically distributed. A Database

Manager (DBM) consists of software which is responsible for processing a segment of the distributed database. Together, the DTM and the DBM make up the DDBMS. The interaction between the DTMs and DBMs is the key consideration for aviation commands, due to the inconsistent connectivity inherent in mobile commands. If one of the action interfaces should fail, training record data should still be available until connectivity can be reestablished.

Distributed Database Architecture

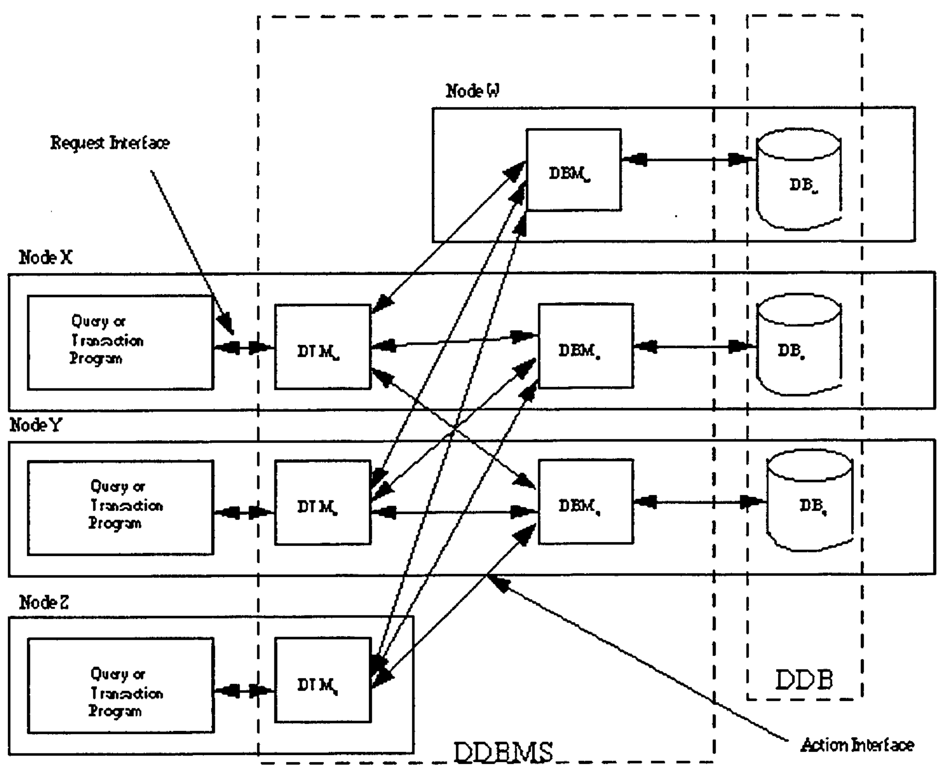

Figure 1. Distributed Database Architecture

A distributed database provides many advantages including:

1. Capacity and incremental growth – as the organization grows, new sites can be added with little or no upheaval to the DBMS

2. Reliability and availability – when a portion of the system (i.e. a school) is down, the overall system remains available. With replicated data, the failure of one site still allows access to the replicated copy of the data from another site. The remaining sites continue to function. The greater accessibility enhances the reliability of the system

3. Efficiency and flexibility – data is physically stored close to the anticipated point of use. If usage patterns change, then data can be dynamically moved or replicated to where it is most needed.

4. Database sharing – users at a given site are able to access data stored at other sites and at the same time, retain control over the data at their own site

A distributed DBMS should provide a number of features which make the distributed nature of the DBMS transparent to the user. A list of these transparencies include:

1. Location Transparency – means that users/programs should not need to know where the data is stored

2. Replication Transparency - means that partitioned/replicated updates must be propagated through to all copies in existence. Replication is desirable and transparent

3. Performance Transparency

4. Transaction Transparency

5. Copy Transparency

6. Fragment Transparency

7. Schema Change Transparency

8. Local DBMS Transparency

Basically, the distributed database should look and feel like a centralized system to the users. (Noel, 1997)

3. Scalability

Scalability is one of the most important features of a true distributed system. If a design is not scalable, it will only suffice in a static world. As ships and squadrons are activated, decommissioned, moved from point-to-point, or reorganized, the scalability of the training record database system should remain as painless as possible. It is important to ensure that the system is able to handle scale-up in such a way as to not interrupt operations.

IV. TRANSACTION PROCESSING ISSUES

A. INTRODUCTION

A transaction is a series of operations on data items in the database that can effect the overall state of the database. The aviation training record database would ultimately be designed to serve all naval aviation and school commands, initiating transactions to the database on a consistent basis. These transactions must be protected with mechanisms to ensure data completeness and accuracy. This chapter, will discuss problems and possible solutions inherent in the performance of multiple transaction processing in a training record distributed database system.

B. ACCESS PRIVILEGES

In the design of the system, it is necessary that an administrator(s) determine operating rights. Not all commands or personnel will require full access to training record information. For instance, it may be possible that some personnel have access to data at a certain level (maybe read only) while other personnel have access to that same data with update privileges. Restricting modification privileges will enhance data integrity.

Structured Query Language (SQL) provides two methods for implementing security restrictions. These are:

- Views – can be provided to hide sensitive data
- Grant/Revoke – grants or removes access privileges to specific users for specific tables.

Like other systems the security provided by SQL is not perfect. A would be infiltrator may possibly find a way of breaking the controls. In situations where data is sufficiently sensitive, other methods would have to be implemented as well. Aviation training records do not normally contain sensitive data and, therefore, do not require strict security.

C. DATA CONCURRENCY

There may be an occasion when a duplicate entry to the database is made. For example, an update may be made by a school in the main database with a later entry being performed from a remote location, perhaps after being temporarily unable to access the main database, during synchronization with the main database. Another example would be a command, such as a school, and the parent command both making identical course completion entries in the main database.

There are currently two generally accepted methods used by DBMS schedulers for concurrency controls in a distributed database system. Concurrency controls must apply the mutual exclusion principle to conflicting operations. Conflicting operations are defined as two or more operations in different transactions in which one or more of the operations from the different transactions writes to a data item that is processed by at least one other active transaction.

1. Timestamping

Timestamp techniques all rely on the fact that transactions can be assigned a unique identifier (the timestamp) which can be thought of as the transaction's start time.

Timestamping differs from locking in that it synchronizes the interleaved execution of transactions in such a way that it is equivalent to a specified serial execution. As there are no locks available to prevent a transaction from seeing uncommitted changes, it is necessary to defer all physical updates to commit time (so that uncommitted changes, as such, are in fact never created).

For a given transaction, if any physical update cannot be performed for any reason, then none of that transaction's physical updates is performed (the transaction is assigned a new timestamp and restarted). (Dublin, 1995) Because of intermittent connectivity problems, inherent with ships at sea, a combination of timestamping and batch processing (discussed later in this chapter), may provide a viable solution.

2. Two Phase Locking

Another widely used method of concurrency control is referred to as the two phase locking protocol. This protocol is used like the timestamp method to solve synchronization problems. Essentially, each data item has a lock. For a transaction to perform an operation on a data item, it must first obtain a lock. There are two kinds of locks, a **read** lock and a **write** lock. Before a transaction can obtain a lock, it must check to see if a lock is currently held by any other transaction on the desired data item. If a read lock exists, it is okay for the transaction requesting the lock to get a read lock on that data item, but not a write lock. A transaction that holds a read lock on a variable, can upgrade it to a write lock, assuming that no other transaction currently holds a read lock on that variable. Transactions can only obtain a lock if they have not previously released any

locks. This implies that transactions go through a growing and shrinking phase of obtaining and releasing locks. This can lead to a situation of deadlock in which one transaction is waiting for a data item locked by another transaction, which in turn is blocked, waiting for a data item held by the first transaction. (Noel, 1997) Data lock on a global scale, could possibly lead to extended periods of denial of service for some users, therefore, locking may be used as a mechanism at the unit level, but will not provide a viable solution for global update.

D. DATA ENTRY AND UPDATE

Integrity is the property of the data in a database at some point in time being consistent with a set of rules, or constraints. Maintaining database integrity involves ensuring data in the database is accurate. Data integrity is important in a multi-user database system because the data is shared, for without appropriate controls it would be possible for one user to update the database incorrectly, which could cause problems for other users.

1. Integrity Controls

An integrity control involves the avoidance of semantic errors and semantically inconsistent database states through the observance and monitoring of database integrity constraints. Commonality in data entry would be incorporated through list boxes and format checking. For example, the only entries that can be made is that format provided in the list box. Integrity control can be carried out by the database management system automatically by means of a monitor, created using *triggers* or *stored procedures*. In

principle, this allows any type of transaction to be performed; however, the database management system rejects those transactions which would impair the consistency of the database.

2. Database Synchronization

The ideal way to allow multiple personnel access to a training record database is to serve one copy of the database from a database server, preferably on a dedicated machine. Since the data is always stored in one place, there's never a question of which version is the most recent. Unfortunately, it's not always efficient for everyone to access a copy of a database running off one server. For example, you might have squadron personnel who need to take copies of the database to remote areas on their laptops during squadron detachments or an entire squadron onboard a ship, during deployment. When a database is kept in more than one place, you must synchronize the information, ensuring that all copies of the database contain the most recent information.

Commercial synchronization applications are available to perform this task. One example is a program by Datasync, a division of I-55 Internet Services Inc, called DataSync. DataSync is middleware that sits between the PC or laptop computer and the master database. Over the network, DataSync selects and downloads precisely the data required by the remote users.

Once the data is downloaded, users can disconnect from the network and access, modify, and add to the data on their individual computers, using existing applications.

When a user reconnects to the network, DataSync synchronizes the user's extract of the database with the master database.

DataSync does a field-by-field analysis of both databases, recognizes and merges data that has changed, bringing both copies of the database up-to-date. DataSync may not be capable of handling a database as large as the training database will require, rather it is given purely as an example of the current capability of COTS synchronization programs available on the market. (Hallogram, 1999) Identifying a suitable program will be a task for further thesis research.

a. Synchronization Speed

Personnel detached to remote areas are especially susceptible to synchronization speed difficulties. Mobility implies that end-user bandwidth is at the mercy of the location. To reduce online time, a store-and-forward data synchronization model could be implemented. In this architecture, changes are queued up and delivered in a batch to the server and vice-versa. Once the bi-directional transfer is complete, the user can go offline (mobile) and his or her machine can complete the processing while disconnected from the server.

b. Unreliable Communication Links

An inherent problem with mobile communications is that sessions can sometimes be unreliable. It is incredibly frustrating for end users to have to restart a communications session from the beginning if the line drops after 20 minutes, resulting in possible data integrity problems caused by the incomplete delivery of transactions to and

from the server. To counter this, the mobile system should have checkpoint and restart capabilities. A transaction must be dealt with in an atomic operation, meaning that if something impedes the transaction from finishing, then the database should be restored to the state it was in, prior to the beginning of the execution of the transaction. In addition, the data synchronization system should ensure that transactions are serialized and that they won't be processed out of order in the event that the communication system becomes unstable.

In order to minimize synchronization times, the commands synchronization model should allow only data that has changed, to be synchronized, vice downloading an entire record or database.

E. CONNECTIVITY ISSUES

There are occasions when connectivity cannot be achieved, either by network failure or lack of connections to Internet resources, as is sometimes the case in remote locations. In addition, ships on deployment may be restricted from sending or receiving data due to communications silence. As a result, the main training database may not be able to receive updated record information from a remote location.

Standalone applications will permit update of the remote database record files during occasions when the remote computer is unable to access or relay updated training record information to the main database. Transferring this updated information can be accomplished by alternate methods.

1. E-Mail

A database file which is updated on a remote PC or laptop computer can be transferred to the parent command by transferring the updated database file through email. This will allow the file to be received, as soon as, the connectivity to the mail server is once again achieved by the receiving command effectively competing the data transfer. Download times will vary, depending on the bandwidth available.

2. Batch Processing

Batch processing is a method by which a series of written instructions (or code) assigns a job to a computer directing the system handle the processing of a job without user assistance. A job can be started manually by an operator or can be programmed to run at a predetermined time, such as, during non-peak hours when the system is not tasked with priority traffic and bandwidth is not as critical, on ship for example, or it can be programmed to run when the system is powered up.

Records are be placed in a batch queue (a list of jobs waiting to be executed). The batch might contain new records to be inserted into the master file, or it might include changes to be applied (called *batch updates*) to previously existing records in the current master file.

When the batch file starts processing a job, the front end starts up the appropriate link (which starts in a dormant state), and a simple communication channel is established between the link and the front end. This communication lets the front end control processing, and keeps it up to date on the status of the job.

Batch processes can be written to perform a number of tasks. This could include an instruction designed to check email attachments for the training record database files and automatically update the main database using the attached data.

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V. APPLICATION PROGRAM DESIGN

A. INTRODUCTION

This chapter will discuss required and desired functionality of an aviation training record application program. The functionality discussed here may not reflect all potential capabilities that an automated record can offer, however, it will provide an example for further thesis research and prototype development.

B. USER INTERFACE

The user interface will provide the means for the aviation maintenance manager or records custodian to interact with the records database. Although the desktop PC has been in existence since the early 70s, it is still a point of apprehension for many people. Therefore, the user interface should be relatively straight forward and as "user friendly" as possible, permitting the novice user effortless navigation through a record.

1. Required Sections

The OPNAVINST 4790.2G dictates that aviation training records contain the following sections:

1. Current Letters/Certificates of Designation/Qualifications
2. Government Motor Vehicle and Support Equipment (SE) Licenses
3. Medical Certifications (audiograms, x-ray screening, laser eye testing and flight deck physical)
4. Course completion certificates (FASO and NAMTRAGRUDET, except for SE Phase I training)
5. Personal Qualification Standards (PQS)
6. Personal Advancement Requirements (PARs)
7. Billet/Collateral Duty Descriptions
8. NAMP Training
9. In-Service Training Syllabus
10. NAVOSH/Safety Training
11. Ordnance Training (if applicable)

12. MTIP M01 Report
13. Ejection Seat Check-out Form (if applicable)

These same requirements must be reflected in the automated record as well. Figure 2 is a screenshot example of a possible interface for the SE licensing section. Again, this may not be an inclusive depiction of functional possibilities, however, it does show one possible example using Microsoft Visual Basic 6.0 as a design tool.

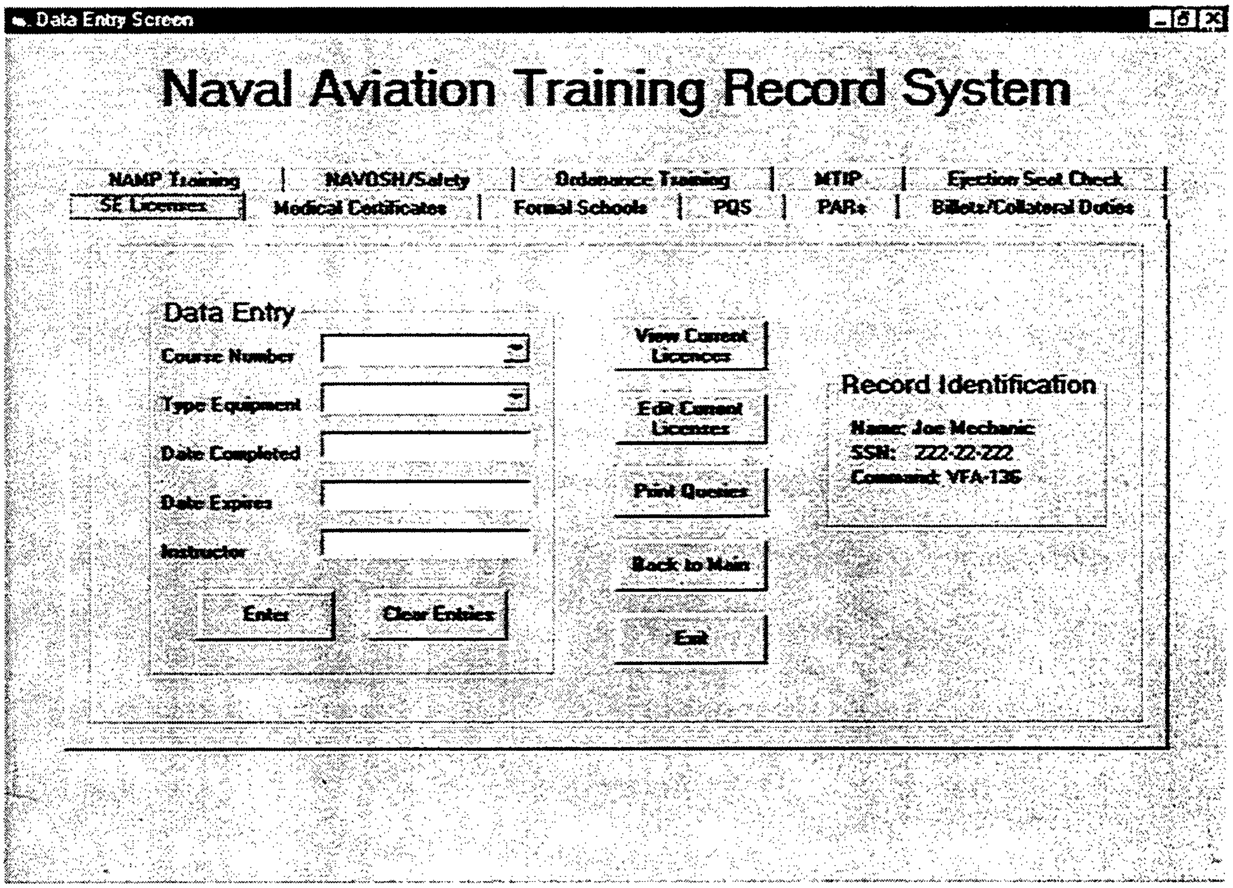

Figure 2. Sample SE License Section Interface

2. Additional Functionality Consideration

Training is a continuous evolution. Initial training is given as personnel report to their commands with scheduled follow-on refresher training performed throughout an

individuals tour. The Workcenter Training Petty Officer must review documented training of all individuals in the workcenter for training due and schedule training lectures as necessary, in order to ensure currency. Depending on the effectiveness of the Training Petty Officer's method of tracking training due dates, required personnel training may be overlooked until the deficiency is finally detected. To aid in detecting training due, the application should be capable of checking due dates and automatically flag individual records for training coming due. During daily login the Training Petty Officer will be alerted well in advance, allowing him or her to schedule refresher training before it becomes overdue. This will eliminate the need to review each record individually or by reviewing a query.

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VI. LAN IMPLEMENTATION CONSIDERATIONS

A. INTRODUCTION

As a result of the Navy's IT-21 initiative, aviation commands have incorporated LAN technology down to the squadron level. Large commands, such as Aircraft Intermediate Maintenance Departments, have WAN connectivity as well. In order to take full advantage of the benefits of automation discussed in previous chapters, a command will need to be running computers connected to an Ethernet LAN. In the event that commands are not equipped with a LAN, standalone applications can be a feasible alternative. WAN connectivity is not a necessity for record automation, although it would pay dividends in portability. This chapter will discuss implementation strategies for incorporating training record automation at aviation commands.

B. NETWORKING APPLICATIONS

1. Standalone Applications

Squadrons are often detached on missions to remote areas of the world. An example of this would be an E-2 Hawkeye squadron assigned to drug enforcement operations in Guantanamo Bay, Cuba or Roosevelt Roads, Puerto Rico. The length of these detachments could span up to as much as two to three months in the case of drug enforcement operations. When detached to remote areas, squadrons are often required to set up squadron operations out of a hangar or building with no LAN services. Standalone applications are designed to be operated on a single computer (or laptop) without a

network. Automated training records on a standalone system would require an application program be physically placed on each hard drive of each computer used for viewing and maintenance of training records.

a. Record Access

Network interaction for this type of application is usually limited to using files from a file server. Access to training records in a non-networked standalone application would have to access an individual training record through an internal database or from an external magnetic medium, such as a floppy disk, Zip disk or CDROM. Although a simple database can be maintained on an individual PC using tools, such as, Microsoft Access, these databases can take up valuable hard drive space, depending on the number of records and amount of data to be stored. In addition, unless the training record database on each computer is updated each time data an individual record is updated, multiple out-of-date databases will exist, which make maintaining individual databases on each PC difficult. Using database synchronization, discussed in more detail in Chapter IV is one option to counter this problem.

b. Peer-to-Peer Networking Option

An inexpensive alternative for sharing files on a standalone application is to configure the computers as a peer-to-peer network, Figure 3. By placing a Network Interface Card in each PC to be networked, the PCs could achieve limited connectivity through 10baseT cable in a bus configuration.

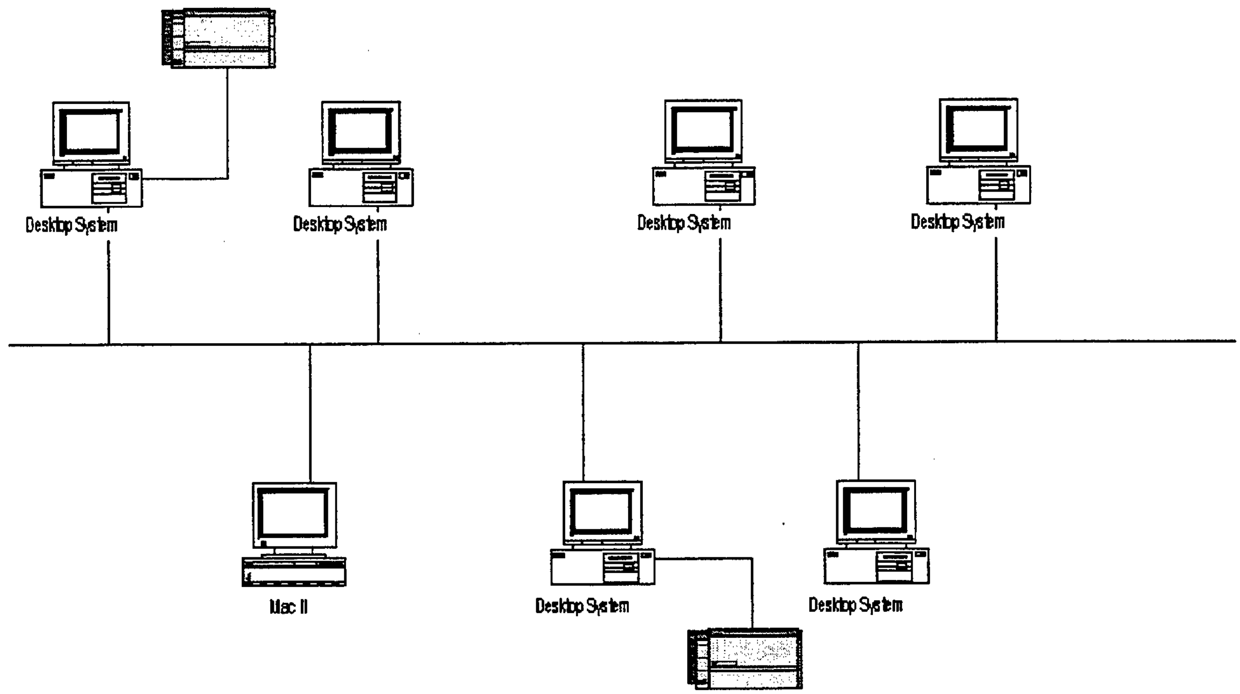

Figure 3. Peer-to-Peer Network

In this configuration, each PC on the network will be able to share files, as well as printers and disk drives. Operating systems, such as, Windows 95/98, Windows 2000, Windows NT Workstation, Windows NT Server (acting as a 'member server") or Apple's Macintosh support peer-to-peer capabilities. Materials for constructing a peer-to-peer network (cable, hubs and connectors) could be easily packed by the detachment and quickly configured at the temporary location.

c. *Advantages/Disadvantages*

The benefit of a standalone application is that the training record application program can be placed only on PCs that require user access. However, this

could prove to be an administrative burden each time a PC is replaced or upgraded, requiring the application be loaded on the new or replacement PC. In addition, any upgrades to the records application program would require loading on each individual PC needing the upgrade.

There is always the possibility with external magnetic media, that multiple copies of an individual's training record may exist. Commands should take steps in controlling users from making multiple copies. Multiple copies of records run the risk of containing data that is not current with the master database, depending on when the copy was made, either by personnel making personal copies or for risk management in the event of database failure. Implemented controls, such as timestamping, discussed in Chapter IV, could provide notification to the user of outdated data contained on the disk and allow the user to upload subsequent changes

2. Network Versions of Standalone Applications

Network versions of standalone applications are basically identical to their standalone counterparts, with the exception that they are designed to be compatible with networking software, are able to take advantage of networking functions, and can be used by several users. This allows an application to be shared on a network server. Shared applications can be a benefit for network administrators. An important advantage is that only one version of the software has to be installed rather than going around installing it on each user's workstation. Upgrades involve upgrading only the version on the server. This ensures that an up-to-date, standard program is being used by all users. It also allows

for centrally located administrative access controls. Only personnel requiring access to the training application program will be allowed through centrally administered mandatory access controls, including user authentication. Although access to the application can now be administratively controlled, record accessibility still mirrors the difficulties associated with the standalone application.

A disadvantage to this model is that in the case of a network failure, the user will be unable to access the training record application program on the application server. Because of this maintaining at least one standalone application on a PC may prove valuable for risk management, so records may still be updated until the network is back in operation.

3. Network-Only Applications

Aviation maintenance managers rely on timely information in order to base daily decisions and plan for future maintenance evolutions. Personnel qualifications play an important part in basing these decisions, therefore, immediate accessibility of these training records is a highly desirable facet of aircraft maintenance management. The most efficient method of allowing personnel the use of a shared training record database is to implement record accessibility in a client/server network, Figure 4. Three network models will be discussed: centralized applications, shared-file system applications, and client/server applications.

a. Centralized Applications

In a centralized application environment, users connect to a central host computer such as a server or mainframe either by using a dedicated terminal, such as an TN3270 plus, or by opening a terminal session on a PC. The application program and the record database would be located on servers to allow simultaneous access by several users. The server or mainframe performs all processing and data storage with the PC merely acting as a dumb terminal. An aviation maintenance manager would have immediate access to all training records in the command regardless of how many users are currently accessing the database. An advantage to this model would be that the application and database could be centrally administered, as well as, user access controls.

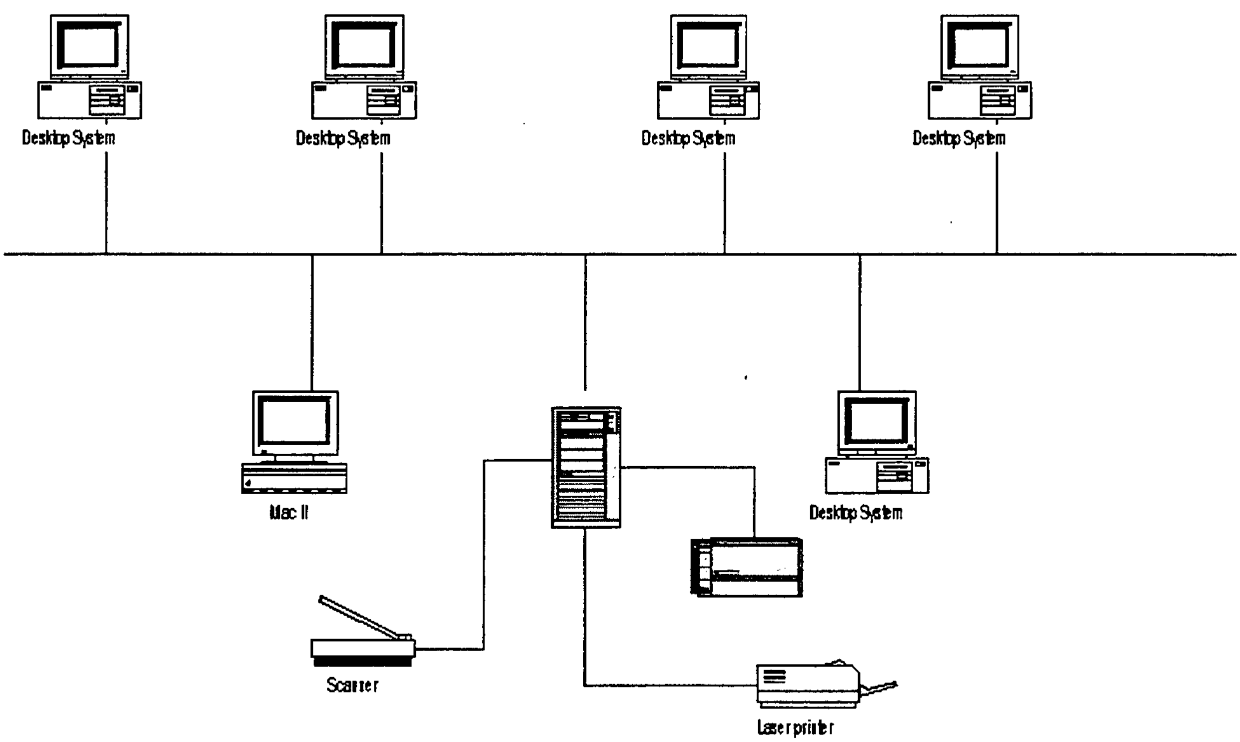

Figure 4. Client/Server Network

b. Shared-file System Applications

In a shared-file application, all processing is performed on a client PC and the server is used only for file storage. This allows the sharing of a central training record database over the network. Again, personnel authorized access to these records, will be able to simultaneously view any record, at any time, from their desktop PC via the network. Access controls may be implemented by the system administrator, using mandatory access controls (MAC) available in operating systems such as Windows NT or by using database access controls. The advantage of this model over the centralized model is that in the event of a network failure, the training record application program will still be accessible from the client PC. Records could then be accessed from external disk files.

c. Client/Server Applications

Client/server applications combine the advantages of both centralized application and shared-file system applications. Client programs handle user interaction and display, whereas server programs perform extensive data processing. Desktop PCs have more than enough computing power to handle window manipulation and user input; however, they might not have the processing power to perform large database indexing and searching operations that would be required by command with greater than a hundred training records, such as an Aircraft Intermediate Maintenance Department (AIMD) facility. A server can be equipped with enough resources to accomplish large scale data manipulation and perform all backend processing. The server will also enable several

managers to simultaneously access training record data resources, regardless of whether it is a Web site or a network database.

While making more efficient use of both client and server components, the only major disadvantage to client/server applications is that they can often be more difficult to configure than shared-file systems or host-based systems; however, client/server networks have become widely adopted in naval commands as part of the Navy's IT-21 initiative, which is focused on providing Navy and Marine Corps commands with the most up-to-date computer and network technology.

C. SHIPBOARD USE

As the Navy advances in meeting it's IT-21 goals, ships are slowly being outfitted with the newest in commercial LAN technology. Naval ships, such as an aircraft carrier, USS Kitty Hawk (CV-63) and the naval amphibious ship USS Belleau Wood (LHA-3), have completed their installations and initial testing of the system at sea. (Brewin, 1999)

Until shipboard LANs are fully implemented, an alternative means of maintaining training records during deployment must be available. Unless a ship allows space on the ship's servers for storage of the training record database, the squadron will still have the option of using a standalone application, maintaining training record information on individual disks for the duration of the deployment. Upon return from deployment, or in rare circumstances, access to a modem line becomes available, a squadron would be able to update the server database through synchronization.

D. WIDE AREA NETWORK CONNECTIVITY

A benefit of electronic training records is that they may be transmitted to external commands using current LAN/WAN technologies. The available technology of the Internet provides a majority of the world's access to external databases through web based systems. Dial-up telephone connections and connections over packet-switched networks further enhance access capabilities, allow connectivity to training record information from remote locations.

1. Dial-up Telephone Connections

With the use of a modem, a computer can be connected to another computer over a phone line. However, because the Public Switched Telephone Network (PSTN) is circuit switched, the quality of a connection can vary each time a connection is made. Analog modem transmission speeds currently stand at approximately 53 Kbps, however, electromagnetic interference (EMI) generally limits dial-up connections to slower transmission speeds. Integrated Services Digital Network (ISDN) provides all-digital connections with speeds up to 128 Kbps and is less susceptible to EMI. In addition, Digital Subscriber Loop (DSL) and cable modem technology may be available, with speeds of approximately 1.5 Mbps for DSL and 2-10 Mbps for cable.

Although not the most efficient medium available today, dial-up connections will allow access to a command training record database from any PC equipped with a modem, providing the command's network is configured for remote access service (RAS) and the capabilities exist at the remote location or the command provides web based

access through the Internet. This will provide maintenance managers the capability to access a record from a home PC or any remote location with an active telephone line and an available RJ-11 wall jack. Security is provided through password and authentication controls.

2. Navy/Marine Corps Intranet

In a message to naval commands in January 2000, Admiral Johnson, Chief of Naval Operations, wrote:

> SECNAV, and I have directed the establishment of a Navy/Marine Corps Intranet (N/MCI) to provide enterprise wide, end-to-end information network capability. Currently, many commands throughout DoN, procure, administer, and operated their own information systems; an approach that is expensive, vulnerable, and inefficient...This variety of applications and security mechanisms impedes the sharing of knowledge and information, and increases training costs. (CNO Washington DC, 101341Z JAN 00)

The N/MCI will incorporate LAN/WAN connectivity through desktop PCs, using existing Internet infrastructures. Scheduled to be in place by the end of the year 2001, the N/MCI will reach over 300 Navy and Marine Corps sea/shore commands throughout the world, using Wide Area Network access, ISDN, commercial WAN, Internet technology and portable satellite communications). (Brewin, 2000)

At the time of this writing, there has been criticism concerning the success of this project due to expected funding constraints and the difficulties inherent in a project of this magnitude. If implemented, however, maintenance managers will be able to access training records, as well as other qualification information, from practically anywhere in

the world, including deployed activities and ships at sea, through satellite communication links. N/MCI will also connect commands to available training information from various sources throughout the world. For example, a squadron could theoretically connect to the Chief of Naval Education and Training's STASS/NITRAS database which contains a history of formal schools and resulting qualifications achieved by personnel.

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VII. RISK MANAGEMENT

A. INTRODUCTION

Intermediate connectivity is a common type of denial of service for users of LANs and WANs. A prime example is the Internet. When the Internet Service Provider (ISP) goes down for scheduled or unscheduled purposes, navigating the Internet is impossible until the ISP is back on line. The same is true when a LAN server or any physical network component such as a hub fails; accessing application and database files become degraded, if not impossible. Synchronization with other distributed database systems is an option, however, this may not be available for immediate reconstruction of the database, due to WAN connectivity problems. Because of this, it is imperative that a command incorporates a contingency plan, to sustain operations in the event of a network failure. A contingency plan should include the use of backups to prevent loss of data and alternative methods to continue operations until problems can be resolved. This chapter will discuss risk management considerations for ensuring continuous use of automated training records.

B. BACKUPS

One of the easiest mechanisms to prevent data loss problems is to use some type of backup system. When determining what backup system will be used, the command should carefully consider the following steps:

1. Develop a schedule for backing up data. The command should consider how often training record data is changed and how critical the data is to the commands mission. This will determine how often the data needs to be backed up.
2. Identify the person (or persons) who will be responsible for maintaining backups and ensure that he or she understands his or her responsibilities.
3. Select a magnetic tape drive. Most backup systems use tape drives with removable cartridge tapes to back up data. The type of tape drive the command chooses will depend on the volume of data to be backed up, the speed at which the drive needs to operate, and the costs associated with both the drive and media.
4. Determine what methods will be used to back up the data. As shown in table 1, there are several different methods of performing data backups. (York, 1992) A reliable backup system will use a combination of methods.
5. Identify storage locations both onsite and offsite. At the command, data backups should be stored somewhere that is easily accessible. An alternate location should be used, offsite, to store backup tapes where the tapes can be retrieved after a catastrophe.

Although a backup system can provide a high level of data security, it requires that someone change the tape before each nightly backup. If someone does not change the tape, some backup data will be lost. It is important to note that these backup methods are not intended to provide a full backup of the entire distributed database system, however, it does provide protection against failure of the individual segments of the database that tie into the system.

Method	Description
Full Backup	Backs up all selected files, regardless of whether they have changed since the last backup, and marks them as backed up.
Copy	Backs up selected files without marking them as backed up.
Incremental	Backs up and marks selected files only if they have changed since the last backup.
Daily Copy	Backs up all files modified on a given day, without marking the files as backed up.
Differential	Backs up selected files only if they have changed since the last backup, but does not mark files as backed up.

Table 1. Backup Methods

C. EXTERNAL MAGNETIC MEDIA

Although an automated training record will make documenting training data in paper form and maintaining a folder on each individual person obsolete, there may still be a need to maintain a separate record from that in a database, on some form of external magnetic media, such as a floppy disk, Zip disk or CDROM. In the event of a network failure, a separate external disk would enable access and update of individual training records until the failure can be resolved and the system back on line. In addition, if the contingency plan developed by the command includes using another command assets in the case of system failure, the affected command will be able to temporarily access and update training records on the other command's system assets using external media. Therefore, it is important for an external disk file be updated each time a record on the database is updated to ensure accuracy of data on both storage mediums.

Unlike paper folders, a magnetic disk will only require a fraction of the storage space required by paper folders. Enforced access controls on the system will still provide a degree of access to the information contained on these external files.

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VIII. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Training Record Necessity

Today's naval aircraft are complex, highly sophisticated weapons and flight control systems. Because of this, personnel maintaining these aircraft must possess and maintain the knowledge and skills necessary to safely and efficiently perform required maintenance tasks. Without the proper training, personnel run the risk of injury or death to themselves or other or possibly the loss of aircraft and crew. In order to document and track qualifications and complete training by aviations maintenance personnel, a training record must be maintained to ensure that the maintenance manager assigns only qualified personnel to perform a maintenance tasks. As aircraft system continue to gain complexity, aviation training records will be a requirement for years to come.

2. Difficulty in Maintaining Paper Records

The training process is a continuous evolution. Personnel are required to receive periodic and refresher training, which needs to be documented in their individual training record. Because of this and the requirement of transferring personnel to hand carry these records from one command to the next, these paper files are constantly handled, causing them the wear. The training petty officer is normally the sole individual tasked to maintain the workcenter's records. Paper records can make maintenance, upkeep and data entry a difficult and time consuming task. The manhours spent on record maintenance

could be better utilized on aircraft maintenance or actual training. Availability and access controls are other major issues of maintaining training records in paper files.

3. Automating Training Records

Automating training records will alleviate or even eliminate the difficulties associated with paper records. Standardization, decreased data entry workload, portability, increased record availability, and access control are all important benefits of automation. A system of distributed databases, greatly enhances record update capabilities and availability by pooling similar information contained in other databases such as a CNET's STASS/NITRAS database. Synchronization will provide a method of updating information contained in individual databases to ensure data consistency and integrity of all databases in the system. To the user, the system will look and feel like a centralized system, with much of the transaction processing being transparent. A "user friendly" standard application interface should allow even the timid of computer users effortless access to the records.

4. Mobility

The mobility of naval aviation commands creates unique circumstances that must be addressed for an effective distributed database system. Transporting automated records from one command to another, whether during personnel transfer or when moving records between ship and shore in preparation for deployment or detachment can be achieved by connectivity to Internet resources. Connectivity, however, is not always achievable either from lack of resources or, in the case of a ship at sea, computing and

bandwidth considerations. Connectivity through satellite communications is the primary mode of data transfer at sea, however, communications silence and other priority traffic may preclude transmitting training record information until operationally feasible. This may require using email and batch processing to counter this problem. Upon return from deployment, or when connectivity to the Internet is acquired through pier side services, normal synchronization procedures can be performed to update all database information in the system.

Modem access, when available, will allow further connectivity for squadron detachments to transmit and receive training record updates.

In addition, transferring personnel will not be required to hand carry their individual training record, rather the receiving command will be able to receive the training record directly from the transferring command through LAN/WAN technology. In the event that a LAN/WAN connection is not possible (i.e. receiving command does not have connectivity resources), transferring personnel will only be required to carry the training record file on disk for upload in the receiving command's database upon check in. This will in effect, cut down on the bulk on the transfer package.

B. RECOMMENDATIONS

1. Database Model

Implement the aviation training record system into a distributed database system to take advantage of information stored in other locations. At the command level, the records should be networked as a client/server application. Although each networking

scheme discussed in this thesis has it's advantages, accessibility should be a major consideration. Records should be available when needed by the maintenance manager. A client/server system offers immediate simultaneous accessibility to a training record database, along with the added benefit of centralized administrative control of record access and software upgrade. A client/server application would also offer the processing power to perform large database indexing and searching operations.

Connectivity to a WAN through current projects, such as the N/MCI, is highly desirable feature and would increase the effectiveness of automated records, however, it is not necessarily an absolute requirement for automation of training records to be effective.

In order to ensure that mobile units and database servers have the most up-to-date information, a system of synchronization and timestamping should be implemented in the system.

In cases where connectivity is difficult, either by a network failure, communications silence, or when bandwidth requirements are critical, the system should allow batch processing and email as options for later processing as situations permit.

2. Need for a Standalone Application

A standalone application should be available on one or two PCs for risk management. In the event that the database server or the entire network should fail, records would still be accessible through external magnetic media files. A standalone

application would also provide portability for command detachment to remote areas through use of a laptop computer.

3. Backups and Copies of Training Records

At least one source of backup media should be available for risk management. The most beneficial method would be to backup the database on a scheduled basis to a backup tape drive, however, there is still a need for copies on media, such as, floppy disks, Zip disks or rewritable CDROMs, with backups made on these disks each time a record is updated. This will allow a disk to be used on a standalone computer in the event of network or database failure. Timestamping should be incorporated to ensure that the most up-to-date information is being used.

4. Further Thesis Work

Development of a prototype automated training record application program could be pursued for further research on this subject, in order to expedite incorporation into aviation command and eliminate paper records.

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APPENDIX A. OPNAVINST 4790.2G REQUIREMENTS

OPNAVINST 4790.2G, Volume V contains the NAMP Training requirements, and guidelines on the structure of the Aviation Training Record. It also contains a list of required training topics, the chapter in Volume V where an expansion of the requirements can be located and the periodicity of each training in which training is to be obtained.

Topic	OPNAVINST 4790.2	Remarks
Fuel Surveillance Program	Volume V, Chapter 3	Indoc. all personnel engaged in fuel surveillance processes and follow-on as required.
Navy Oil Analysis Program	Volume V, Chapter 4	Indoc. all personnel engaged in NOAP processes and follow-on as required.
Aviators Breathing Oxygen Surveillance Program	Volume V, Chapter 5	Indoc. all personnel engaged in ABO processes and follow-on as required.
Hydraulic Contamination Control Program	Volume V, Chapter 6	Indoc. all personnel, regardless of rating/MOS, prior to performing aircraft, SE hydraulic component maintenance, or hydraulic SE operation and follow-on as required.
Tire and Wheel Maintenance Safety Program	Volume V, Chapter 7	Indoc. all personnel, regardless of rating/MOS, placing emphasis on the hazards associated with aircraft/SE tires and follow-on as required.
Quality Assurance Audit Program	Volume V, Chapter 8	Indoc. all supervisors, program managers, and QAR/CDQAR/CDI personnel on CSEC.
Oil Consumption Program	Volume V, Chapter 9	Indoc. all personnel and follow-on as required.
Naval Aviation Maintenance Discrepancy Reporting Program	Volume V, Chapter 10	Indoc. all personnel and follow-on as required.
Technical Directive Compliance Program	Volume V, Chapter 11	Indoc. all personnel and follow-on as required. Special emphasis for supervisors, Maintenance/Production Control (including Logs and Records) and Material Control personnel and QARs/CDQARs/CDIs.
Foreign Object Damage Prevention Program	Volume V, Chapter 12	Indoc. all personnel and follow-on as required.
Tool Control Program	Volume V, Chapter 13	Indoc. all personnel engaged in aircraft/SE/component repair and follow-on as required.
Corrosion Prevention and Control Program	Volume V, Chapter 14	Indoc. all personnel and follow-on as required.
Plane Captain Qualification Program	Volume V, Chapter 15	Indoc. all personnel and follow-on as required.
Egress System Checkout Program	Volume V, Chapter 16	Indoc. all personnel performing maintenance on aircraft equipped with ejection seats and every (6) months thereafter.
Support Equipment Operator Training and Licensing Program	Volume V, Chapter 17	Indoc. all personnel and follow-on as required.
Support Equipment Planned Maintenance System Program	Volume V, Chapter 18	Indoc. all personnel who use SE and follow-on as required.

Topic	OPNAVINST 4790.2	Remarks
Naval Aviation Metrology and Calibration Program	Volume V, Chapter 19	Indoc. all personnel who use calibrated equipment and follow-on as required.
Hazardous Material Control and Management Program	Volume V, Chapter 20	Indoc. all personnel and follow-on as required.
Individual Component Repair Program	Volume V, Chapter 21	All I-level personnel and follow-on as required.
Electrostatic Discharge Program	Volume V, Chapter 22	Indoc all personnel who handle ESD sensitive devices and follow-on as required.
Miniature/Microminiature Program	Volume V, Chapter 23	Indoc. all personnel and follow-on as required.
Aviation Gas Free Engineering Program	Volume I, Chapter 10	Indoc all personnel engaged in fuel cell/tank maintenance and follow-on as required.
Support Equipment Misuse and Abuse	Volume I, Chapter 10	Indoc. all personnel and follow-on as required.
Emergency Reclamation	Volume I, Chapter 10 (Volume V, Chapter 14)	Indoc. all personnel and quarterly for Emergency Reclamation Team members.
Nondestructive Inspection Program	Volume I, Chapter 10	Indoc. all personnel and follow-on as required.
Maintenance Department Safety Program	Volume I, Chapter 14	Indoc. all personnel and follow-on as required.

NOTE: The requirements listed in Figures 2-1 and 2-2 are not intended to affect the following personnel/naval aviation maintenance programs which require specific training before an individual receives a certification/designation/license:

1. Hydraulic Contamination Patch Test Technician
2. Tire and Wheel Technician
3. QAR/CDQAR/CDI
4. Aviation Gas Free Engineer (AVGFE)
5. Plane Captain
6. Support Equipment Operator
7. Miniature/Microminiature (2M) Technician
8. NDI Technician
9. Aeronautical Welder
10. Explosive Handler
11. Vibration Analysis Technician
12. Test Cell Operator
13. Battery Maintenance Technician
14. Respirator User
15. Oil Analysis Technician
16. Taxi/Turn-up
17. Corrosion Control Formal Training Requirements
18. Enhanced Comprehensive Asset Management System (ECAMS)

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APPENDIX B. MAINTENANCE TRAINING RECORD (LEFT SIDE)

MAINTENANCE TRAINING RECORD

LEFT SIDE

Name: ______________________________ Rate/Rank ________

SSN: ______________________________

1. Current Letters/Certificates of Designation/Qualifications, for example, OPNAV 4790/12.
2. Government Motor Vehicle and Support Equipment (SE) Licenses.
3. Medical certifications, for example, audiograms, x-ray screening, Laser eye testing and flight deck physical.
4. Course completion certificates, for example, FASO and NAMTRAGRUDET; except for SE Phase I training.
5. Personal Qualifications Standards (PQS).
6. Personnel Advancement Requirements (PARs).

PRIVACY ACT STATEMENT

1. Authority for the collection of information: 5 U.S.C. 301, Departmental Regulation and E.O. 9397 (SSN).

2. Information contained in your training record will be used primarily to monitor your training progress and status, and for miscellaneous administrative functions within the Training Department.

3. Completion of this form is voluntary. However, failure to complete the form may result in inaccurate documentation of your training. The principle purpose of the Privacy Act is to enable you to make known your special considerations and authorization for the release of training record information.

I understand that this privacy statement applies to all requests for personnel information made to my training record and that a signed copy in my training record is evidence of this notification. I further understand that I may receive a copy of this statement from the Training Department upon request, and will be informed of changes to the system or records for which this information is compiled and that I have the right to review personal data contained in this record.

______________________________ ________

Signature Date

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APPENDIX C. MAINTENANCE TRAINING RECORD (RIGHT SIDE)

MAINTENANCE TRAINING RECORD

RIGHT SIDE

1. Billet/Collateral Duty Descriptions
2. NAMP Training
3. In-Service Training Syllabus
4. NAVOSH/Safety Training
5. Ordnance Training (if applicable)
6. MTIP M01 Report
7. Ejection Seat Check-Out Form (if applicable)

Division Officer Quarterly for

Rate/Rank Name (Last, First, MI)

Date	Initial	Date	Initial	Date	Initial

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APPENDIX D. SAMPLE OJT SYLLABUS ENTRY SHEET

OJT SYLLABUS: 9101 NAME: ____________________

TA-75 TOW TRACTORS

EQUIPMENT	INST	DATE	INST	DATE	INST	DATE	W/C SUP	DATE
TA-75 A/B								
PMs								
Carburetor Adj								
R&R Carburetor								
Adj Rocker Arms								
Tune Up								
R&R Spark Plugs								
R&R Fan Belts								
R&R Alternator								
Flush Radiator								
R&R Steering Box								
Adj Trans Bands								
R&R Pwr Strg Pump								
R&R Ring Gear								
R&R Starter								
R&R Manifold Gasket								
Brake Job								
Repair Park Brake								
Rebuild Front End								
QEC Engine								
QEC Transmission								
ADDITIONAL TASKING								

TA-75 A/E Page 1 of 1

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APPENDIX E. NAMP INDOCTRINATION ENTRY SHEET

NAMP INDOCTRINATION TRAINING

NAME: ______________________ RATE/RANK: ____________

DATE ARRIVED: ____________

TOPIC	INSTRUCTOR	DATE COMPLETED
Fuel Surveillance Program		
Navy Oil Analysis Program		
Aviators Breathing Oxygen Surveillance Program		
Hydraulic Contamination Control Program		
Tire and Wheel Maintenance Safety Program		
Quality Assurance Audit Program		
Oil Consumption Program		
Naval Aviation Maintenance Discrepancy Reporting Program		
Technical Directive Compliance Program		
Foreign Object Damage Prevention Program		
Tool Control Program		
Corrosion Prevention and Control Program		
Plane Captain Qualification Program		
Egress System Checkout Program		
Support Equipment Operator Training and Licensing Program		
Support Equipment Planned Maintenance System Program		
Naval Aviation Metrology and Calibration Program		
Hazardous Material Control and Management Program		
Individual Component Repair List Program		
Electrostatic Discharge Program		
Miniature/Microminiature Program		
Aviation Gas Free Engineering Program		
Support Equipment Misuse and Abuse		
Emergency Reclamation		
Nondestructive Inspection Program		
Maintenance Department Safety Program		

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APPENDIX F. NAVOSH/SAFETY TRAINING ENTRY SHEET

NAVOSH/SAFETY TRAINING

NAME: ______________________ RATE/RANK: ________

DATE ARRIVED: ____________

TOPIC	INSTRUCTOR/DATE	INSTRUCTOR/DATE	INSTRUCTOR/DATE
NAVOSH Program (Annually)			
NAVOSH: Identification of key personnel and chain of command. (Annually)			
NAVOSH: Mishap Reporting (Annually)			
HAZARD Identification (Annually)			
Safety Precautions and Standards (Annually)			
First Aid and Survival Training (Annually)			
Mishap Prevention (Annually)			
Back Injury Prevention (Annually)			
Hearing Conservation (Annually, if applicable)			
Sight Conservation (Annually)			
First Aid (Quarterly, if applicable)			
Fire Prevention/Equipment (Annually)			
Radio Frequency Radiation (Annually)			
Laser (Annually)			
Battery Safety (Quarterly)			
Cardiopulmonary Resuscitation (CPR) (If applicable)			
Asbestos Hazards (Annually, if applicable)			
Lead (Annually, if applicable)			
Man-Made Mineral Fiber (Annually, if applicable)			
Confined Space Entry (Annually, if applicable)			
Hazard Communication (Annually)			
Hazard Communication OJT (MSDS) (Annually)			

NOTE: This figure is not all inclusive. Refer to applicable instructions for additional requirements.

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APPENDIX G. ACRONYMS

AIDC – Automatic Identification Data Collection

AIMD – Aircraft Intermediate Maintenance Department

AME – Automated Maintenance Environment

CDROM – Compact Disk Read-Only Memory

COTS – Commercial-Off-The-Shelf

CNET – Chief of Naval Education and Training

DAC – Discretionary Access Control

DDB – Distributed Database

DBMS – Database Management System

DDBMS – Distributed Database Management System

DBM – Database Manager

DTM – Distributed Transaction Manager

DoD – Department of Defense

ECAMS – Enhanced Comprehensive Asset Management System

EMI – Electromagnetic Interference

GMT – General Military Training

GSE – Ground Support Equipment

IMA – Intermediate Maintenance Activity

IS – Information System

ISDN – Integrated Services Digital Network

ISP – Internet Service Provider

IT-21 – Information Technology for the 21st Century

Kbps – Kilobits Per Second

LAN – Local Area Network

MIS – Management Information System

MMP – Monthly Maintenance Plan

MTIP – Maintenance Training Improvement Program

NALCOMIS IMA – Naval Aviation Logistics Command Management Information System for Intermediate Maintenance Activities

NALCOMIS OMA – Naval Aviation Logistics Command Management Information System for Organizational Maintenance Activities

NAMP – Naval Aviation Maintenance Program

NAVAIR – Naval Air Command

NAVFLIRS – Naval Flight Record System

NIC – Network Interface Card

N/MCI – Navy/Marine Corp Intranet

NTCSS – Navy Tactical Information System

OMA – Organizational Maintenance Activity

OPNAVINST – Chief of Naval Operations Instruction

PC – Personal Computer

PSTN – Public Switched Telephone Network

RAS – Remote Access Service

RDBMS – Relational Database Management System

SA – Systems Administrator

SECNAV – Secretary of the Navy

SQL – Structured Query Language

STASS – Standard Training Activity Support System

TCP/IP – Transmission Control Protocol/Internet Protocol

TYCOM – Type Commander

WAN – Wide Area Network

Windows NT – Windows New Technology

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